

DOE BERAC Advisory Committee

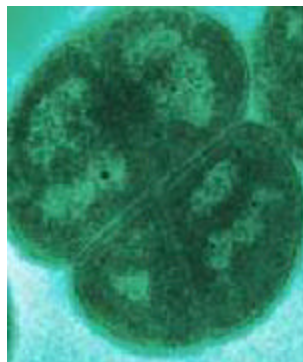
- Provides Program Review, Oversight and Strategic Planning for four Divisions which Enable Basic Science in Support of DOE Missions in Energy and National Security

Life Sciences



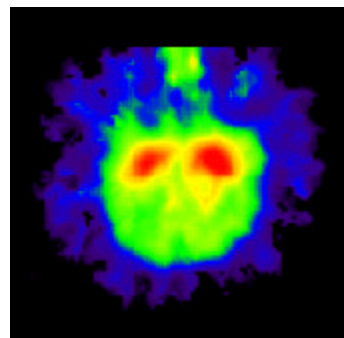
Using structural biology
to understand the
anthrax lethal factor

Environmental Sciences



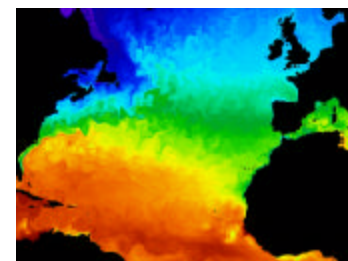
Exploring highly
radiation resistant
bacteria to remediate
toxic wastes

Medical Sciences

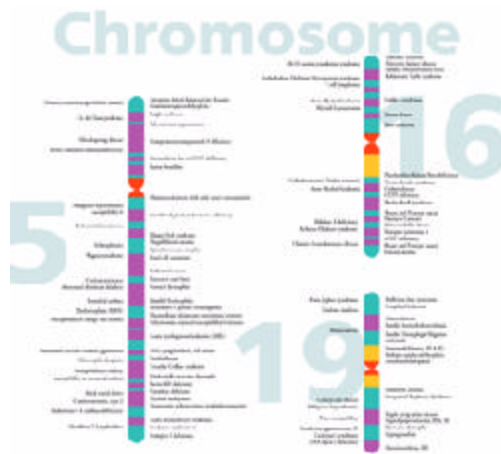
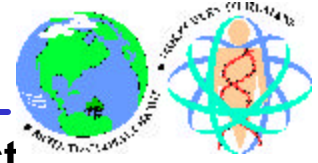


Understanding effects
of cocaine addiction on
the brain

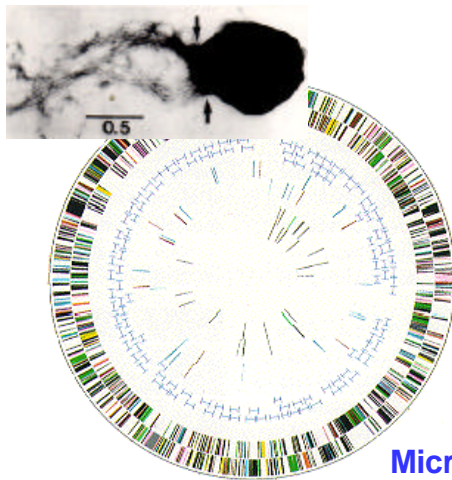
Climate Change



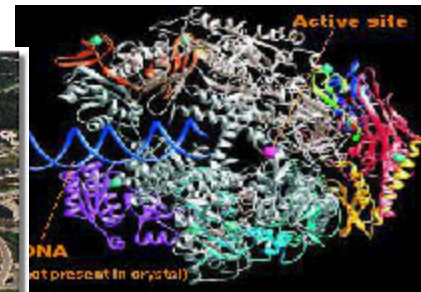
Predicting climate
change on decade to
century scale



Human Genome Project



Microbial Genomics

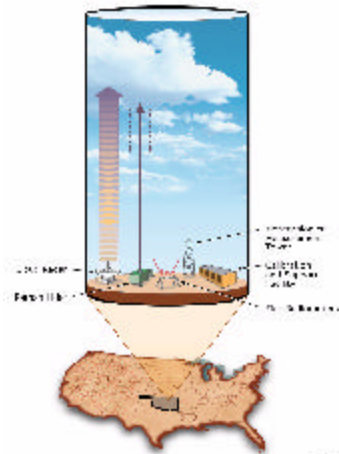
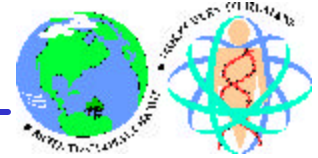


Structural Biology

- ? Initiated the Human Genome Project
- ? Tools and technology impacting *all* DNA sequencing today
- ? Sequenced human chromosomes 5,16,19
- ? Verified existence of a third branch of life
- ? Tools for high throughput proteomics – the next revolution in biology
- ? Science and technology as vital component of detection and defeat of bio terrorist threats
- ? User facilities for determining the structure of the molecular machinery of life

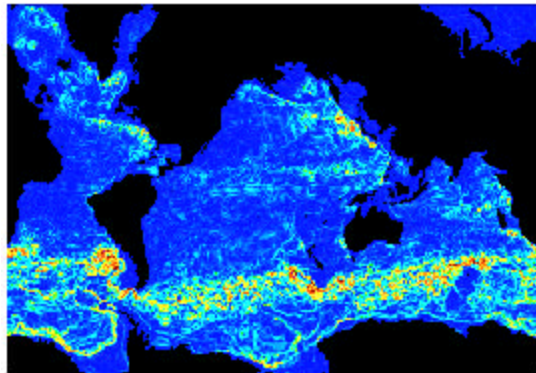
Climate Change Research

DOE-BER

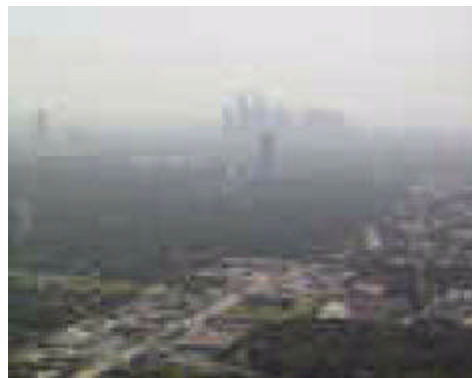


Atmospheric Radiation
Measurement Program
(ARM)

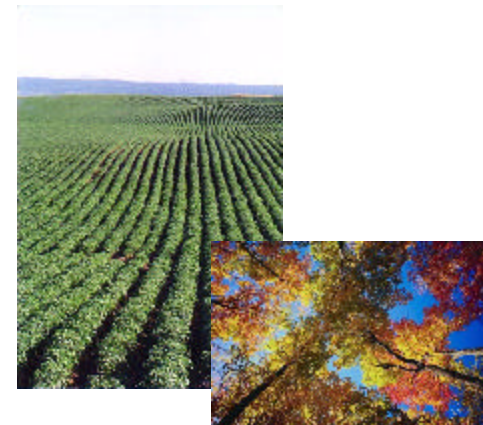
- ? Advanced models to predict global and regional climate over decades to centuries
- ? ARM – reducing the major uncertainty in climate prediction – the role of clouds in controlling solar and thermal radiation
- ? Aerosols – a key uncertainty in atmospheric radiation, climate and human health
- ? A strong participant in interagency U.S. Global Change Program



Climate Modeling



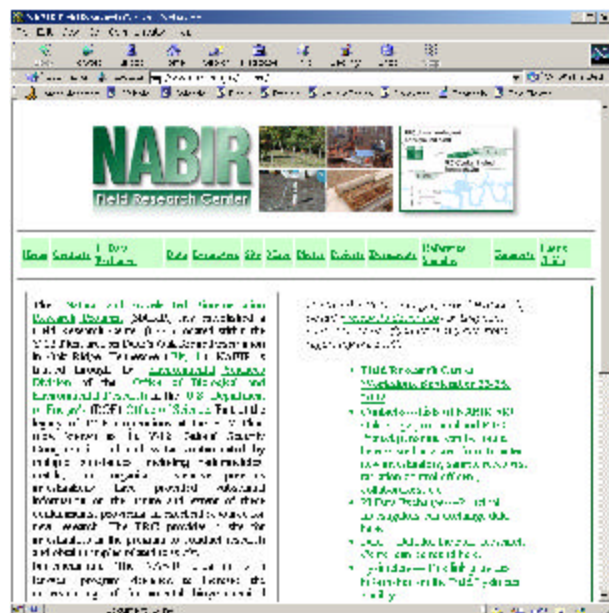
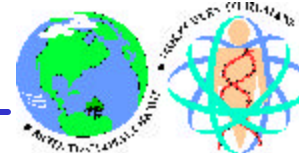
Tropospheric Aerosol Program



The Carbon Cycle - Planetary
Effects and Climate Change

Environmental Sciences

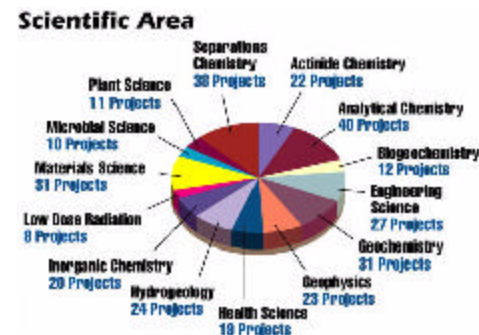
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Bioremediation Research
—Environmental Molecular
Sciences Laboratory

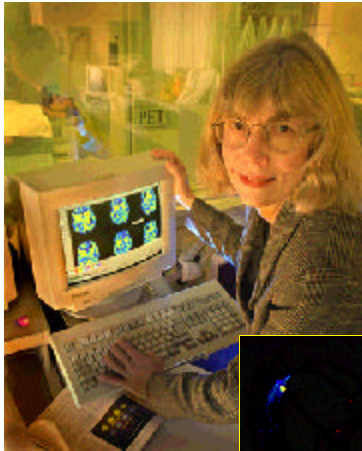
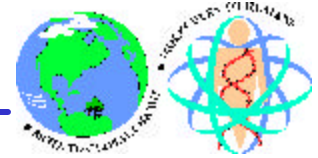
- ? **NABIR** - Natural and Accelerated Bioremediation Research program supports field and lab research in advancing bioremediation
- ? **EMSL** - a national user facility providing a wide array of advanced instrumentation to support environmental research
- ? **EMSP** - environmental molecular science program supports basic research in universities and labs to advance knowledge in environmental sciences and cleanup

EMSP research spans many scientific areas to utilize science in advancing solutions for environmental cleanup

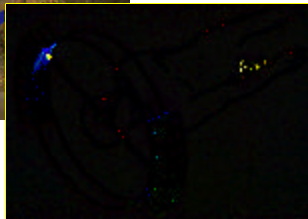


Medical Applications

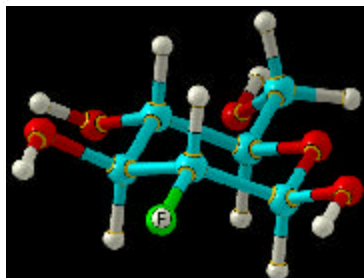
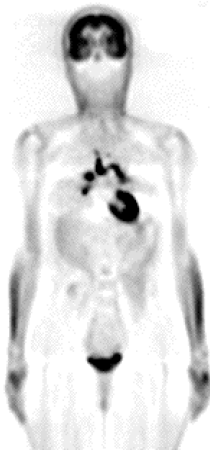
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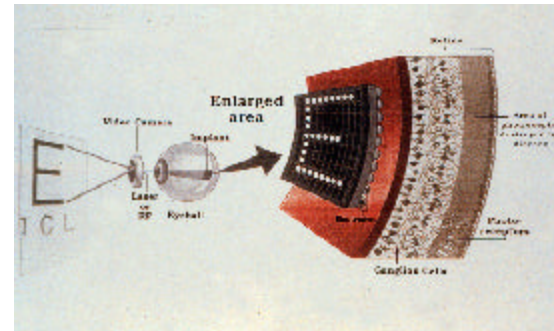
PET Imaging



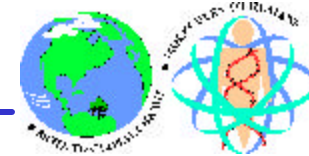
- ? Novel radioisotopes used in diagnosis for millions of patients annually
- ? Positron Emission Tomography (PET) used in hundreds of clinical centers
- ? Digital cameras for mammography
- ? Peregrine – more precise calculation of radiation doses to tumors
- ? Micro electronic chip for artificial sight



Radiopharmaceuticals



Artificial Sight



Primer

Cells contain DNA—the hereditary material of all living systems.

A genome is an organism's complete set of DNA.

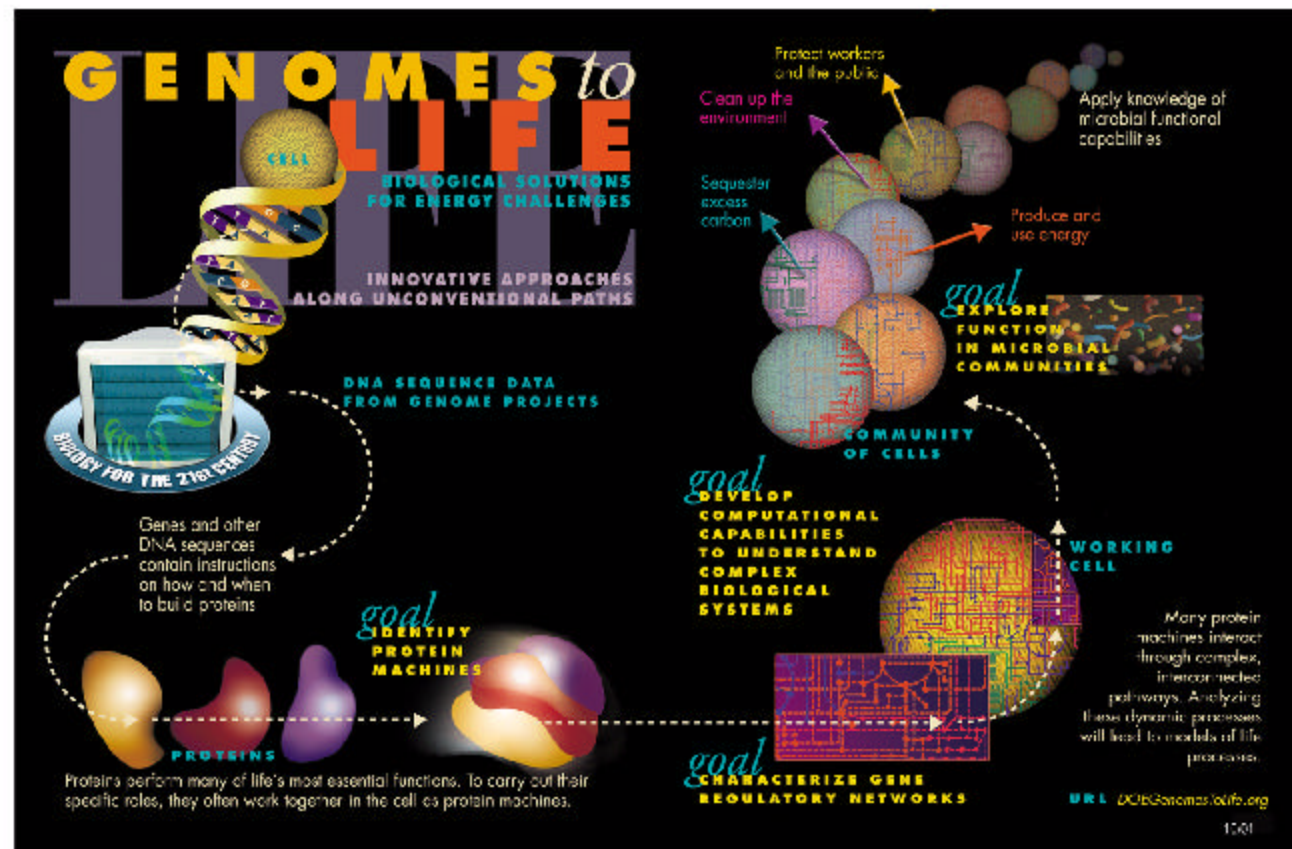
DNA contains genes whose sequences specify how and when to build proteins.

Proteins perform most essential life functions, often working together as highly organized **protein machines**.

Gene regulatory networks act as the on-off switches and rheostats of a cell, specifying what proteins to produce at any given moment.

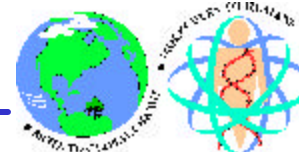
Computer models of living systems will be applied to challenges in energy, environment, and human health protection.

Enabling DOE leadership in scientific advances and innovation to capitalize on the new biology of the 21st century and address mission critical needs



Genomes-to-Life Initiative

DOE-BER



Payoffs for the Nation

Within a Decade

Enable rapid detection of agents and identify molecular targets for new antivirals and antibacterials

Develop knowledge base for cost-effective cleanup strategies

Understand earth's natural carbon cycle and design strategies for enhanced carbon capture

Increase biological sources of fuels and electricity

Long Term

Enhance biowarfare agent detection and response

Save billions of dollars in toxic waste cleanup and disposal

Stabilize atmospheric carbon dioxide to counter global warming

Enable U.S. independence from foreign oil
• Launch major new American industry in bioenergy

2010



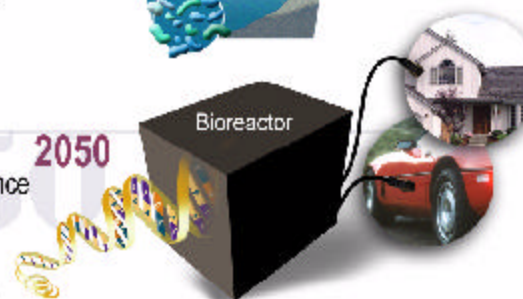
2020



2040

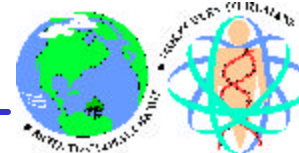


2050

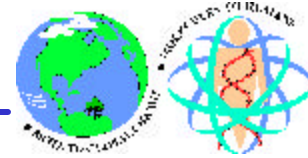


GENOMES to LIFE
BIOLOGICAL SOLUTIONS FOR ENERGY CHALLENGES
INNOVATIVE APPROACHES ALONG UNCONVENTIONAL PATHS

BERAC Position on GTL Future Opportunities **DOE-BER**



- GTL represents a bold vision to evolutionarily build upon core strengths of BER portfolio to capitalize on the genomic revolution
- Goal is to develop with interagency partners in a complementary way an understanding of complex biological systems leading to their use for solving problems in energy, the defeat of bioterrorism, the environment, medicine, agriculture, *etc.*
- Complexity of the challenge requires new facilities and new scientific resources to enable and support the research
- Examples include protein production, data centers and computing resources, new and expanded access to “big” instruments like synchrotrons, NMRs, Mass specs, *etc.*
- BERAC strongly feels that all new investments should be peer-reviewed and open for competition to universities, national labs and where appropriate, industry
- BERAC supports measuring and achieving the best performance possible from BER investments in GTL and focussing new science and technology on DOE missions while advancing the frontier of biological discovery

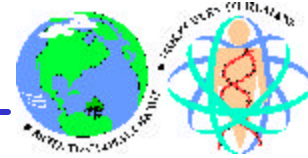


- FY 2002 funding overview

Life Sciences	\$210,878,000
Climate Change Research	\$137,959,000
Environmental Remediation	\$109,530,000
Medical Applications & Measur. Science	\$ 45,848,000

- Current distribution of funds - 61% at national laboratories, 37% at universities and research institutes, 2% construction.
- New/future opportunities (note that funding estimates are planning numbers and do not represent an official position of DOE SC)

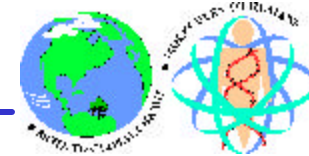
Genomes to Life (10 year program with projected growth to approximately \$200 M/year, up from the current year level in the life sciences budget of about \$40 M/year) Expansion of fundamental research projects and completion of the initial 4 goals of the GTL initiative. Included are creation of new interdisciplinary centers and techniques necessary to enable rapid progress in these complex areas. Future plans include demonstration-pilot projects that will translate basic laboratory research into field-type scenarios that utilize biotechnology based solutions to clean energy production, carbon sequestration, and bioremediation.



- ***Climate Change Research*** (projected growth to approximately \$200 M/year; up from current level of \$138 M/year) – Expansion of broad scientific user capabilities including ARM (Atmospheric Radiation Measurement) sites – full instrumentation of existing sites and new sites to expand the diversity and breadth of global coverage; AmeriFlux sites – further expansion of AmeriFlux research site network to improve our ability to estimate net carbon exchange; and FACE (Free-Air Carbon Dioxide Enrichment) sites – expansion of user base to better understand the effects of atmospheric carbon dioxide on diverse ecosystems.
- ***Environmental Remediation Research*** (projected growth to approximately \$160 M/year; up from current level of about \$110 M/year) – Expansion of research opportunities to include demonstration-pilot projects that translate basic laboratory research into field implementations that develop and test bioremediation solutions for cleaning up metals and radionuclides at DOE (and other) waste sites.
- ***Medical Applications Research*** (projected growth to approximately \$80 M/year; up from current level of about \$46 M/year) – Emphasis on high risk research, upstream (pre-clinical) research in advanced medical imaging (including an ability to “see” the expression of individual genes in patients in real time and an ability to collect images on awake patients), and in nuclear medicine (including the development of novel approaches to target tumors with radionuclide therapy).

For Further Information...

DOE-BER



See:

<http://www.er.doe.gov/production/ober/berac.html>

